

Control growth of various polygonal-shaped h-BN single crystals

Meijo Univ., °Kamal P. Sharma, Aliza K. Sharma, Takahiro Maruyama

E-mail: kamalprasads@gmail.com

Hexagonal boron nitride (h-BN), a structural analogue of graphene, is a wide bandgap 2D insulating layered material, consisting of alternating sp^2 -bonded boron and nitrogen atoms [1]. It shows appealing properties such as thermally stable in air up to 800°C, chemical inertness, stable thermal conductivity and superior elastic properties, and hence has drawn significant attention as a promising material in frontier applications [2]. Although chemical vapor deposition (CVD) technique has developed as the most scalable process to synthesize h-BN on various transition metals, various polygonal shaped single domain h-BN process is unclear and are still limited to few microns in their edge length [3, 4]. In this research, we study the growth kinetics of h-BN crystals larger than 25µm via morphological transition.

For h-BN crystals synthesis, bare Cu foils were heated at 26 °C/min from room temperature to 1050 °C with 100 sccm Ar in horizontal tubular furnace. After annealing the Cu foil for 30 min with 100 sccm H_2 (Method-A) or 100sccm Ar (Method-B), ammonia borate (AB) was evaporated with 100:2 mixtures of Ar and H_2 . 2 mg of AB was heated for various growth interval which are termed as Method- A_A, B_A, B_B, and B_C and the growth furnace was rapidly cooled down to room temperature within 30 min. As synthesized h-BN crystals were analyzed by optical microscopy (OM), Raman spectroscopy, FESEM, XPS, AFM, and EBSD.

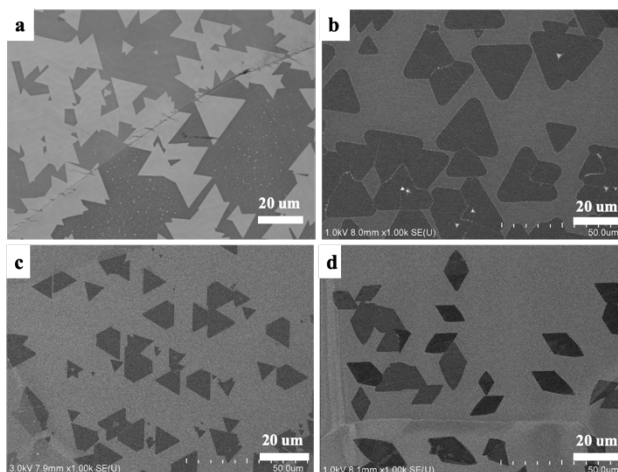


Figure 1. OM image of h-BN crystals synthesized by (a) Method-A_A, and FESEM images synthesized by (b) Method-B_A, (c) Method-B_B, and (d) Method-B_C.

Regular triangular shaped h-BN crystals (**Figure 1(a)**) grown in Method-A_A changed into truncated triangles (**Figure 1(b)**) obtained in Method-B_A. it should be noted that only annealing of Cu in Ar was changed compared to the former one. On decreasing the heating rate of AB, pentagonal and diamond shaped h-BN crystals were synthesized with elapsed growth time (**Figure 1(c-d)**). Hence, various polygonal h-BN crystals were grown larger than 25µm in edge length by controlling the feedstocks supply rate.

This work was supported in part by Private University Research Branding Project from the Ministry of Education, Culture, Sports, Science and Technology (MEXT), Japan.

References

- [1] Kim, K. K. et al., Nano Lett., 12, 161 (2012). [2] Sun, J. et al., Chem. Soc. Rev. 47, 4242 (2018).
- [3] Tay, R. Y. et al. Nanoscale 8, 2434 (2016). [4] Sharma, K.P. et al., CrysEngComm. 20, 550 (2018).